OMEX II Database
Data Documentation Index

Introduction

The database data documentation is structured as a series of documents, each covering the data from one or more database data tables. The following index allows the data documentation for each type of data to be located.

ADCP Data (Table ADCP)

Vertical current velocity profiles measured by underway acoustic doppler current profiler, including signal return amplitude that provides an indication of zooplankton biomass.

Drifting Buoy Data (Table ARGOS)

Tracks of drogued buoys released from OMEX cruises.

CTD Profiles (Table BINCTD)

Vertical temperature and salinity profiles. Some of the profiles also include dissolved oxygen, chlorophyll, optical attenuance and scalar irradiance.

Miscellaneous Instrument Profiles (Tables PRDATA/PRTOTAL)

'Miscellaneous instrument profiles' is a generic term for vertical profiles collected with instruments other than CTDs. For OMEX II it includes XBT, radiometer and FLY probe data.

Water Bottle Data (Table BOTDATA)

A wide range of physical, chemical and biological parameters measured on discrete water samples collected using bottles, pumps (shipboard and in-situ) and landers.

Integrated Water Sample Data (Table INTBOT)

Column integrated chlorophyll data computed from discrete measurements and integrated primary production data computed from PAR profiles and photosynthetic parameters.

Production Data (Tables C14DAT, N15DAT, P33DAT and P33DARK)

Data from long (usually 24 hour) in-situ and on-deck production experiments plus data from non-parameterised P:I experiments.

Bulk Core Measurements (Table CORETOT)

Parameters measured on bulk core samples or grab samples.

Sediment Profiles (Table COREPROF)

Profiles of a wide range of chemical and sedimentological parameters along cores.

Benthic Fauna Data (Tables MEIODAT, MFDAT and MEGADAT)

Benthic meiofauna, macrofauna and megafauna species distribution and biomass data.

Continuous Plankton Recorder Data (Tables CPR_COLOUR, CPR_PHYTO and CPR_ZOO)

Phytoplankton and zooplankton species distribution data from CPR tows through the OMEX II area of interest from 1997-1999.

Net Haul Data (Table NETDATA)

Mesozooplankton abundance and biomass data, plus a range of parameters from experiments carried out on net haul catches.

Sediment Trap Data (Table TRAPDATA)

Parameters measured on the samples collected by the OMEX moored and drifting sediment traps.

Menten-Michaelis Phosphate Uptake Kinetics (Table PUPVPO4)

Phosphate uptake rates from Menten-Michaelis kinetics experiments, in which the phosphate uptake rate by the particulate phase is measured as a function of the PO_4 concentration in the dissolved phase.

Underway ADCP Data

Introduction

Underway acoustic doppler current profilers were operated on a significant number of OMEX cruises. However, these data are of little use in water depths beyond the range of bottom tracking (>3-400 m) unless great care has been taken in the determination of the ship's velocity used to convert relative current velocities into absolute current velocities. Ricardo Torres undertook this work for OMEX II at University of Wales, Bangor.

Instrumentation and Data Acquisition

Both ships (Charles Darwin and Meteor) were fitted with RDI 150 kHz broad band ADCP systems. In addition, Meteor was equipped with a 75 kHz narrow band instrument, which was the primary instrument. However, it started malfunctioning after a couple of days. The 150 kHz instrument was brought in as a backup, but its performance was also intermittent. The data set is consequently a mixture of output from the two instruments.

The 150 kHz transducers were located as follows:

Charles Darwin:	Hull-mounted approximately 4m below the water line
Meteor:	Near the base of the mid-ship moon pool

On Meteor, the 75 kHz transducer was also in the moon pool, but only one ADCP system was running at any one time.

A PC running the RDI DAS software logged the data. The preferred method of data acquisition was to collect the PINGDATA files from the hard disk of the PC. However, these were lost for CD105 and the data logged by the Research Vessel Services Level C (a Sun workstation) via a printer buffer were used instead. Time stamps for both techniques were taken from the PC clock. The problem of time offsets between these and the navigation time stamps have been taken into account during the subsequent processing.

UWB Data Processing

CD105B

The data from the RVS logging system were loaded into Matlab together with GPS navigation data from the ship’s ABC system. Ship’s velocities were computed for each profile from the navigation. Errors in the navigation or ADCP errors in the reference layer (bins 5-15 or 5-20) resulted in the loss of 58 out of a total of 3552 profiles. Bin depths were computed to the top of each bin, taking the transducer depth into account.

The current velocities relative to the ship were converted into absolute current velocities using the procedures described in Pollard and Read (1989). The misalignment angle (the offset between the ADCP and the ship's gyro compass) and scaling factor were determined as –7.2 and 1.02 respectively. Note that the relative velocities stored are uncorrected, but that the correction has been applied during the computation of the absolute velocities.

The data were quality controlled and a profile flag was set to identify those bins where the absolute velocities were suspect. No screening was undertaken on the vertical velocity or amplitude channels.

The originator comments that there is high variability in the data and recommends that they be further averaged, both in the vertical and in time.

CD110A and CD110B

The weather on these cruises was extremely rough and no usable ADCP data were identified.

CD114A, CD114B and M43_2

The data were calibrated using the CODAS system working from the PINGDATA files and the highest resolution navigation available. The ADCP relative velocities were rotated following the procedures described in Pollard and Read (1989).

The following angle and scale values were applied:

CD114A (up to 13:45 on 03/08/1998)	head	179.9	scale	1.0
CD114A (after 13:45 on 03/08/1998)	head	0.0	scale	1.0
CD114B	head	-0.4	scale	1.04
Meteor M43_2 (150 kHz)	head	-1.7 to 0.6	scale	1.01
Meteor M43_2 (75 kHz)	head	-1.9 to 0.3	scale	1.01

The unusually large head value at the start of CD114A was to correct a system configuration error that rotated the currents through 180 degrees.

The Meteor data set is a mix of data from the two instruments because there were serious operational problems during the cruise. Both systems received frequent attention from the ship’s engineers. Whenever possible, data were taken from the 75 kHz instrument. The 150 kHz instrument was used for infilling whenever it was running and the 75 kHz instrument was down.

The data were screened and a quality control flag was set up for each bin in every profile. This ranged from zero (good data) to 3 (garbage). The data were supplied as ASCII dumps of the CODAS database.

BODC Processing and Quality Control

CD105B

The worked up data were supplied by UWB as binary files. These were converted into ASCII SQLLDR (the Oracle data loader) files using simple FORTRAN programs. The headers were loaded into Oracle and the navigation was checked against the underway data held by BODC. No problems were identified. Water depths from the scientific echo sounder were added to the headers from the underway data. The ABC system labelled the ADCP data with the PC clock time at the start of the data acquisition interval. This has been stored as the event start time. Adding the sampling interval to the start time set the event end times.

The load program filtered the binned data, rejecting any bins that had all channels flagged as suspect. Checks were made on the absolute current data to ensure that they hadn't been corrupted during processing. No problems were identified.

CD114A, CD114B and M43_2

The CODAS dumps were converted into a BODC internal format (QXF: a NetCDF subset). The originator's quality control flags were translated on the following basis:

0	Good data – flagged ' '
1	Suspect data – flagged 'K'
>1	Garbage – discarded

The BODC ADCP calibration program was then run to compute the absolute current velocities from the rotated relative velocities and the navigation-derived ship velocities stored in the input file. The calibrated velocities were screened using the XERPLO graphic editor. A small number of obviously anomalous values that had not been flagged by the originator were flagged as suspect ('M').

The data from the start of CD114A did not look good and had been heavily flagged by the originator. It is recommended that the data prior to 00:00 on 03/08/1998 are ignored.

The screened data were loaded into Oracle. Event start and end times were derived as half a cycle interval before and after the source file time stamps. Position and water depth were derived from the underway data file on the basis of these times.

Drifting Buoy Data

Introduction

The OMEX II drifting buoy data set includes the space/time co-ordinates and sea surface temperature measurements from drogued buoys released from Charles Darwin CD114B and Meteor M43_2.

Drogued Buoys

The drifters released were of two types. Horizon Marine Inc. buoys were deployed from CD114B and SERPE-IESM® spherical (40cm diameter) buoys were deployed from M43_2. Both were mixed layer drifters equipped with cylindrical ‘Holey Sock’ drogues (8m length, 1.5m diameter) located at a nominal depth of 15m.

All the drifters measured the water temperatures with an accuracy of ±0.3°C and the data were transmitted with every positioning message. The buoys were tracked by the Argos satellite system for between 5 days and seven months after deployment.

Integrated Water Sample Data

Parameter Code Definitions

INCAFLP1 Depth-integrated fluorometric chlorophyll-a
Profile integration of fluorometric assays of acetone extracts (GF/F filtered)
Milligrams/m^2

INPPPIC1 Integrated primary production
Computed from P:I data and measured light profile
Milligrams/m^2/day

INPPPIC2 Integrated primary production
Computed from P:I data and wavelength-dependent phytoplankton absorption coefficients
Milligrams/m^2/day

Originator Code Definitions

Belgica cruise BG9714C

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163	Dr. F. G. Figueiras	IIM, Vigo, Spain

Belgica cruises BG9815C, BG9919B and BG9919C

72	Prof. Roland Wollast	ULB, Brussels, Belgium

Charles Darwin cruises CD110B and CD114A

163	Dr. F. G. Figueiras	IIM, Vigo, Spain

Originator Protocols

Professor Roland Wollast

Photosynthesis versus irradiance experiments were performed in either 200 or 600 ml culture bottles in an artificial light gradient from 0 to 800 µE/m^2/s in a bath maintained at constant temperature by circulating surface seawater. Incubation times were limited to 6-8 hours. The relationship between ^{14}C uptake and light intensity has been parameterised following the model of Platt et al. (1980).

The light profiles were measured using a LiCor irradiance quantum sensor attached to a SeaBird SBE19 CTD package. This had a bandwidth of 400-700 nm and was calibrated in units of $\mu E/m^2/s$. The instrument sampled at 0.5 Hz. Temperature and salinity were also measured by the CTD package but these were deemed inferior to the SBE9 plus profiles obtained on the same stations and were discarded. There were problems with the profiles from this instrument on Belgica BG9714C and the data from the IIM instrument (see below) were used instead.

Chlorophyll data were obtained by filtering water samples through GF/F filters, which were placed in plastic vials and flash frozen in liquid nitrogen. Back in the laboratory, the pigments were extracted into 90% acetone and the resulting extracts were assayed fluorometrically, following the protocols of Yentsch and Menzel (1963).

Dr. F. G. Figueiras

Photosynthetic parameters were estimated using photosynthesis-irradiance (P-E) experiments. Samples were pipetted into 75 ml Corning tissue culture flasks and inoculated with 1.85 X 10^5 Bq (5 μCi) $NaH^{14}CO_3$. They were incubated in a linear incubator, maintained at the sea temperature of the chlorophyll-a maximum using a Polyscience digital temperature controller. Osram tungsten-halogen lamps with a dichroic reflector and a Deco glass cover illuminated the incubator from the side. The irradiance in each cell was measured using a Li-Cor Li-109SA cosine sensor. The spectral irradiance at each location in the incubators was calculated from the relative mean spectrum of the tungsten-halogen lamps $\times$ the corresponding photosynthetic available radiation at each point. The last bottle in the incubator was covered with aluminium foil as a dark control.

The samples were incubated for 2-3 hours, after which the suspended material was vacuum filtered through 25mm Whatman GF/F filters. The filters were fumed for 12 hours with HCl and then frozen. Disintegrations per minute (DPMs) were determined on return to the laboratory using a Packard Tri-Carb 2500 TR liquid scintillation analyzer using the external standard and the channel ratio methods to correct for quenching.

The P-E data were fitted to the model of Platt et al. (1980).

Downwelling vector irradiance spectra were measured at a resolution of 1nm over the range 350-750nm using a LiCor UW-1800 profiling spectroradiometer. The instrument was deployed to depths of up to 60m either manually or with the aid of a small winch. At each depth sampled (typically 5-10m apart) a full spectrum was recorded in response to a command from the logging computer. The reading labelled 0m was taken with the instrument on deck. Great care was taken to ensure that spectra were not recorded whilst the instrument was shaded by the ship.

The light absorption coefficient of phytoplankton was determined using a single beam, Beckman DU 650 spectrophotometer. Samples were filtered through glass fibre (GF/F) filters and the absorption at wavelengths of between 400 and 700 nm was measured on the filters. The light absorption by non-algal material was determined after extraction of pigments from the filter using absolute methanol. The light absorption coefficient was calculated from the absorption spectra minus the absorption of the non-algal material.

Chlorophyll-a was determined by filtering water samples through GF/F filters and freezing them. Back in the laboratory, the pigments were extracted into 90% acetone and fluorometrically assayed following the protocols of Yentsch and Menzel (1963).

The daily-integrated primary production in the water column was estimated using two models. The first used PAR irradiance, and the second used the wavelength dependent absorption spectra of phytoplankton. Both models integrated the primary production down to the 0.1% irradiance layer.

Production Data

Introduction

The production data tables hold the results of uptake experiments that cannot sensibly be mapped into the water bottle data table (BOTDATA) because the amount of supporting information required exceeds what can be included in an 8-byte parameter code. The data in these tables come from two sources. First are the 24-hour ^{14}C, ^{15}N and ^{33}P experiments carried out by PML (Principal Investigator: Dr. Ian Joint) in screened on deck incubators or in-situ incubation rigs. Secondly, there are normalised ^{32}P uptakes determined over a light gradient in an artificial light incubator by ULB, Brussels (Principal Investigator: Dr. Lei Chou). The detailed protocols of these investigators are given below.

Dr. Ian Joint

Sampling

Experiments were carried out on Charles Darwin CD105B, both legs of Charles Darwin cruise CD114 and Poseidon cruise PS237_1. Water samples were collected using 10-litre Niskin bottles deployed on the CTD rosette at up to 8 depths. All samples were collected pre-dawn and care was taken to keep exposure of the samples to light to a minimum through the use of subdued lighting during experimental manipulations.

Note that in some cases (e.g. most casts on PS237_1) the number of incubation light levels exceeded the number of depths sampled. In these cases the provenance of the water for each incubated sample may be obtained using the IBTTLE field in the data tables.

^{14}C Fixation

Four acid-cleaned polycarbonate bottles were filled from each depth sampled and each bottle was inoculated with 10µCi $NaH^{14}CO_3$ solution. The specific activity of each stock solution was determined immediately after inoculation of the experimental samples by adding aliquots to a CO_2-absorbing scintillation cocktail and counting immediately in a liquid scintillation counter.

One bottle from each depth was wrapped with aluminium foil and tape to exclude all light. After an incubation period of 24 hours, the bottles were filtered sequentially through 5µm, 2µm and 0.2µm pore size polycarbonate filters. The filters were dried in a desiccator and the samples were counted on return to Plymouth in a liquid scintillation counter. During CD114, the samples were counted at sea. Counting efficiency was determined by the external standard channels ratio method.

^{15}N Fixation

Replicate samples were distributed into clear polycarbonate bottles and $^{15}NO_3$ and $^{15}NH_4$ were added. During CD114B, ^{15}N-urea was also added.

The concentrations of added isotope were kept as low as practicable and are documented below for each cruise. The ambient concentrations of nitrate and ammonium were determined by conventional colorimetric methods on all cruises except CD114B where the more sensitive methods of chemiluminescence and fluorometry were used. The ambient urea concentrations were determined following the method of Goeyens et al. (1998).

Charles Darwin CD105B

Date	Sample depth (m)	$^{15}NO_3$ added (μM)	Ambient NO_3 (μM)	$^{15}NH_4$ added (μM)	Ambient NH_4 (μM)
12/06/1997	0	0.008	0.09	0.008	<0.1
	10	0.008	0.07	0.008	<0.1
	15	0.008	0.05	0.008	<0.1
	20	0.008	<0.05	0.008	<0.1
	25	0.008	<0.05	0.008	<0.1
	35	0.008	<0.05	0.008	<0.1
	45	0.008	<0.05	0.008	<0.1
	60	0.008	0.18	0.008	<0.1
13/06/1997	0	0.008	<0.05		
	5	0.008	<0.05		
	10	0.008	<0.05		
	20	0.008	<0.05		
	30	0.008	<0.05		
	40	0.008	<0.05		
	50	0.008	<0.05		
14/06/1997	0	0.016	<0.05	0.073	<0.1
	10	0.016	<0.05	0.073	<0.1
	15	0.016	<0.05	0.073	<0.1
	20	0.016	<0.05	0.073	<0.1
	25	0.016	<0.05	0.073	<0.1
	35	0.016	<0.05	0.073	<0.1
	45	0.016	<0.05	0.073	<0.1
	60	0.048	0.33	0.073	<0.1
15/06/1997	0	0.008	<0.05	0.081	0.13
	10	0.008	<0.05	0.081	<0.1
	20	0.008	<0.05	0.081	<0.1
	30	0.008	<0.05	0.081	<0.1
	35	0.008	<0.05	0.081	<0.1
	45	0.008	<0.05	0.081	<0.1
	60	0.016	<0.05	0.081	<0.1
	80	0.484	3.02	0.081	<0.1

Date	Sample depth (m)	$^{15}NO_3$ added (μM)	Ambient NO_3 (μM)	$^{15}NH_4$ added (μM)	Ambient NH_4 (μM)
16/06/1997	0	0.008	<0.05	0.065	0.11
	10	0.008	<0.05	0.065	<0.1
	15	0.008	<0.05	0.065	0.12
	20	0.008	<0.05	0.065	<0.1
	25	0.008	<0.05	0.065	<0.1
	35	0.008	0.25	0.065	<0.1
	45	0.04	0.43	0.065	<0.1
	60	0.403	4.05	0.065	<0.1
17/06/1997	0	0.008	<0.05	0.008	<0.1
	10	0.008	<0.05	0.008	<0.1
	15	0.008	<0.05	0.008	<0.1
	20	0.008	<0.05	0.008	<0.1
	25	0.008	<0.05	0.081	<0.1
	35	0.008	<0.05	0.081	<0.1
	45	0.016	0.17	0.065	<0.1
	60	0.323	3.64	0.056	<0.1
18/06/1997	0	0.008	<0.05	0.008	<0.1
	5	0.008	<0.05	0.008	<0.1
	10	0.008	<0.05	0.008	<0.1
	20	0.008	<0.05	0.008	<0.1
	25	0.008	<0.05	0.008	<0.1
	30	0.008	<0.05	0.008	<0.1
	40	0.008	<0.05	0.008	<0.1
	50	0.008	<0.05	0.008	<0.1
19/06/1997	0	0.008	<0.05	0.008	<0.1
	10	0.008	<0.05	0.008	<0.1
	15	0.008	<0.05	0.008	<0.1
	20	0.008	<0.05	0.008	<0.1
	25	0.008	<0.05	0.008	<0.1
	35	0.008	<0.05	0.008	<0.1
	45	0.008	<0.05	0.032	<0.1
	60	0.024	0.15	0.032	<0.1
20/06/1997	0	0.008	<0.05	0.008	0.11
	5	0.008	<0.05	0.008	<0.1
	10	0.008	<0.05	0.008	<0.1
	15	0.008	<0.05	0.008	<0.1
	20	0.008	<0.05	0.008	<0.1
	25	0.008	<0.05	0.008	<0.1
	30	0.008	<0.05	0.008	<0.1
	40	0.016	0.1	0.008	<0.1

Poseidon PS237_1

Date	Sample depth (m)	$^{15}NO_3$ added (μM)	Ambient NO_3 (μM)	$^{15}NH_4$ added (μM)	Ambient NH_4 (μM)
28/02/1998	0	0.008	0.6	0.014	0.09
	5	0.008	0.56	0.014	0.18
	10	0.008	0.52	0.014	0.14
	14	0.008	0.54	0.014	0.09
	17	0.008	0.47	0.014	0.1
	23	0.008	0.43	0.014	0.06
	30	0.008	0.72	0.014	0.07

Date	Sample depth (m)	$^{15}NO_3$ added (μM)	Ambient NO_3 (μM)	$^{15}NH_4$ added (μM)	Ambient NH_4 (μM)
28/02/1998	40	0.008	1.06	0.014	0.15
01/03/1998	5	0.008	0.05	0.014	0.28
	10	0.008	0.01	0.014	0.28
	14	0.008	0.01	0.014	0.15
	17	0.008	0.35	0.014	0.24
	23	0.008	0.33	0.014	0.1
	30	0.008	0.36	0.014	0.1
	40	0.008	0.68	0.014	0.11
02/03/1998	5	0.008	0.03	0.01	0.1
	10	0.008	0.01	0.01	0.14
	14	0.008	0.02	0.01	0.13
	17	0.008	0.28	0.01	0.11
	25	0.008	2.05	0.01	0.2
	30	0.008	1.52	0.01	0.1
	40	0.008	1.61	0.01	0.08
03/03/1998	5	0.008	0.09	0.01	0.11
	10	0.008	0.07	0.01	0.19
	10	0.008	0.07	0.01	0.19
	15	0.008	0.07	0.01	0.21
	20	0.008	0.14	0.01	0.2
	27	0.04	0.21	0.01	0.22
	35	0.04	0.49	0.01	0.18
05/03/1998	0	0.04	0.02	0.014	0.2
	10	0.04	0.02	0.014	0.23
	15	0.04	0.02	0.014	0.23
	20	0.04	0.01	0.014	0.25
	35	0.04	0.07	0.014	0.24
	60	0.04	1.71	0.014	0.11
06/03/1998	5	0.008	0.7	0.014	0.18
	10	0.008	0.44	0.014	0.11
	15	0.008	0.22	0.014	0.15
	20	0.008	0.34	0.014	0.19
	27	0.008	0.55	0.014	0.18
	35	0.04	0.73	0.014	0.15
07/03/1998	5	0.02	0.58	0.014	0.09
	10	0.02	0.61	0.014	0.23
	15	0.02	0.65	0.014	0.21
	20	0.02	0.68	0.014	0.23
	27	0.02	0.78	0.014	0.16
	35	0.02	0.83	0.014	0.14
08/03/1998	5	0.008	0.33	0.014	0.26
	10	0.008	0.22	0.014	0.25
	15	0.008	0.14	0.014	0.24
	20	0.008	0.07	0.014	0.26
	27	0.008	0.01	0.014	0.28
	35	0.008	0.6	0.014	0.17
09/03/1998	5	0.02	0.02	0.014	0.21
	10	0.02	0.07	0.014	0.18
	20	0.02	0.12	0.014	0.27
	30	0.02	0.15	0.014	0.09
	40	0.02	0.21	0.014	0.13
	50	0.02	0.48	0.014	0.13
10/03/1998	5	0.008	0.02	0.014	0.09

Date	Sample depth (m)	$^{15}NO_3$ added (µM)	Ambient NO_3 (µM)	$^{15}NH_4$ added (µM)	Ambient NH_4 (µM)
10/03/1998	10	0.008	0.01	0.014	0.27
	15	0.008	0.04	0.014	0.2
	20	0.02	0.06	0.014	0.14
	27	0.02	0.2	0.014	0.14
	35	0.02	0.32	0.014	0.09
11/03/1998	5	0.008	0.36	0.014	0.09
	10	0.008	0.38	0.014	0.15
	15	0.008	0.34	0.014	0.13
	20	0.008	0.37	0.014	0.08
	27	0.02	0.51	0.014	0.15
	35	0.02	0.8	0.014	0.12
12/03/1998	5	0.02	0.79	0.014	0.11
	10	0.02	0.83	0.014	0.14
	20	0.02	0.77	0.014	0.1
	27	0.02	0.71	0.014	0.15
	35	0.02	0.67	0.014	0.17
13/03/1998	5	0.02	0.82	0.014	0.15
	10	0.02	0.86	0.014	0.14
	15	0.02	0.88	0.014	0.09
	20	0.02	0.97	0.014	0.11
	27	0.02	0.98	0.014	0.12
	35	0.02	1.21	0.014	0.07

Charles Darwin cruise CD114A

Date	Sample depth (m)	$^{15}NO_3$ added (µM)	Ambient NO_3 (µM)	$^{15}NH_4$ added (µM)	Ambient NH_4 (µM)
03/08/1998	0	0.047	0.30	0.016	0.16
	10	0.047	0.39	0.016	0.15
	15	0.047	0.94	0.016	0.13
	20	0.047	2.21	0.016	0.11
	25	0.047	2.40	0.016	0.11
	30	0.047	3.57	0.016	0.08
	40	0.047	3.85	0.016	0.09
04/08/1998	0	0.039	0.40	0.008	0.15
	5	0.039	0.40	0.008	0.15
	10	0.047	0.67	0.008	0.06
	15	0.047	0.65	0.016	0.17
	20	0.047	0.77	0.016	0.13
	25	0.120	1.11	0.016	0.08
	30	0.120	1.24	0.008	0.12
	40	0.230	1.69	0.008	0.15
05/08/1998	0	0.020	0.05	0.008	0.22
	5	0.020	0.05	0.008	0.22
	10	0.020	0.15	0.008	0.14
	15	0.029	0.33	0.016	0.17
	20	0.029	0.40	0.016	0.12
	25	0.029	0.66	0.008	0.13
	30	0.059	1.45	0.008	0.19
	40	0.059	2.49	0.008	0.19
06/08/1998	0	0.008	<0.05	0.020	0.08
	5	0.008	<0.05	0.020	0.08

Date	Sample depth (m)	$^{15}NO_3$ added (µM)	Ambient NO_3 (µM)	$^{15}NH_4$ added (µM)	Ambient NH_4 (µM)
06/08/1998	10	0.008	<0.05	0.020	0.11
	15	0.023	0.27	0.020	0.13
	20	0.051	0.49	0.020	0.15
	25	0.059	0.55	0.020	0.14
	30	0.059	0.47	0.020	0.19
	40	0.117	1.11	0.020	0.18
07/08/1998	0	0.008	<0.05	0.008	0.05
	5	0.008	<0.05	0.008	0.05
	10	0.008	<0.05	0.008	0.05
	15	0.008	<0.05	0.008	0.05
	20	0.008	<0.05	0.008	0.05
	25	0.008	<0.05	0.008	0.05
	30	0.031	0.06	0.008	0.05
	40	0.078	2.78	0.008	0.05
09/08/1998	0	0.008	<0.05	0.016	0.05
	5	0.008	<0.05	0.016	0.05
	10	0.039	0.22	0.016	0.05
	15	0.117	1.80	0.016	0.05
	20	0.117	2.18	0.016	0.05
	25	0.117	2.18	0.016	0.05
	30	0.117	2.93	0.016	0.05
	40	0.117	4.15	0.016	0.05

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Date	Sample depth (m)	$^{15}NO_3$ added (µM)	Ambient NO_3 (µM)	$^{15}NH_4$ added (µM)	Ambient NH_4 (µM)	^{15}N Urea added (µM)	Ambient urea (µM)
14/08/1998	0	0.012	0.005	0.012	0.011	0.025	0.14
	5	0.012	0.005	0.012	0.011	0.025	0.14
	10	0.012	0.005	0.012	0.006	0.025	0.03
	15	0.012	0.005	0.012	0.005	0.025	0.03
	20	0.012	0.005	0.012	0.004	0.025	0.03
	25	0.012	0.005	0.012	0.011	0.025	0.03
	30	0.012	0.005	0.012	0.007	0.025	0.03
	40	0.012	0.040	0.012	0.004	0.025	0.03
15/08/1998	0	0.012	0.006	0.012	0.018	0.025	0.14
	5	0.012	0.006	0.012	0.018	0.025	0.14
	10	0.012	0.005	0.012	0.025	0.025	0.13
	15	0.012	0.005	0.012	0.044	0.025	0.03
	20	0.012	0.005	0.012	0.029	0.025	0.02
	25	0.012	0.004	0.012	0.023	0.025	0.03
	30	0.012	0.024	0.012	0.017	0.025	0.15
	40	0.012	0.824	0.012	0.019	0.025	0.03
16/08/1998	0	0.008	0.005	0.008	0.006	0.025	0.13
	7	0.008	0.005	0.008	0.006	0.025	0.13
	12	0.008	0.003	0.008	0.006	0.025	0.30
	18	0.008	0.005	0.008	0.006	0.025	0.03
	22	0.008	0.006	0.008	0.006	0.025	0.21
	29	0.008	0.005	0.008	0.006	0.025	0.03
	50	0.008	0.172	0.008	0.010	0.025	0.09
17/08/1998	0	0.008	0.003	0.008	0.010	0.025	0.03
	5	0.008	0.003	0.008	0.001	0.025	0.03

Date	Sample depth (m)	$^{15}NO_3$ added (µM)	Ambient NO_3 (µM)	$^{15}NH_4$ added (µM)	Ambient NH_4 (µM)	^{15}N Urea added (µM)	Ambient urea (µM)
17/08/1998	10	0.008	0.006	0.008	0.002	0.025	0.02
	15	0.008	0.006	0.008	0.002	0.025	0.05
	20	0.008	0.003	0.008	0.006	0.025	0.03
	25	0.008	0.003	0.008	0.007	0.025	0.29
	30	0.008	0.003	0.008	0.006	0.025	0.13
	45	0.012	0.454	0.008	0.003	0.025	0.03
18/08/1998	0	0.008	0.006	0.008	0.038	0.025	0.03
	5	0.008	0.006				
	10	0.008	0.004				
	15			0.008	0.043	0.025	0.03
	20	0.008	0.004	0.008	0.041	0.025	0.60
	25	0.008	0.004	0.008	0.055	0.025	0.29
	30					0.025	0.13
	50	0.016	0.196	0.008	0.037	0.025	0.19
19/08/1998	0	0.008	0.003	0.008	0.010	0.025	0.34
	6	0.008	0.003	0.008	0.010	0.025	0.34
	11	0.008	0.006	0.008	0.010	0.025	0.31
	19	0.008	0.003	0.008	0.010	0.025	0.48
	26	0.008	0.003	0.008	0.010	0.025	0.27
	34	0.008	0.003	0.008	0.010	0.025	0.07
	45	0.156	0.454	0.008	0.010	0.025	0.32

The ^{15}N samples were filtered (<40cm Hg vacuum) through pre-ashed Whatman GF/F filters which were rinsed with filtered sea water and stored frozen until analysis back at the laboratory. During CD114A size-fractionated data were obtained by screening an incubated sample through a 2-micron pore filter prior to filtering through the GF/F. The filters were dried and stored over silica gel in a desiccator until analysed.

Atomic percentage ^{15}N was measured by continuous-flow nitrogen analysis mass spectrometry (Europa Scientific Ltd.) using the techniques described by Barrie et al. (1989) and Owens and Rees (1989). The rates of assimilation were calculated using the equations of Dugdale and Goering (1967).

^{33}P Fixation

Phosphate uptake was measured in a similar manner to carbon uptake, except that the tracer added was $^{33}PO_4$. After incubation the samples were filtered through 5µm, 2µm and 0.2µm polycarbonate filters, which had been boiled in lithium chloride phosphate buffer. After samples were filtered, each filter was rinsed with lithium chloride phosphate buffer, using the method of Grillo and Gibson (1979), to remove any adsorbed ^{33}P. The filters were counted on board ship in a liquid scintillation counter and counts were adjusted for half life and quenching corrections.

Incubation

All samples were incubated either in-situ (the preferred method) or at a range of light levels behind neutral density screens in an on-deck incubator, cooled with circulating surface seawater for 24 hours from dawn to dawn. At night the on-deck incubator was covered to ensure that there was no influence of the ship's lights on primary production. All incubations during CD105B and PS237_1 were on-deck, but most of the incubations during CD114 were in-situ. The TYPE field in the HDR tables documents indicates the type of incubation for each experiment.

For the in-situ incubations the bottles were fixed to clear acrylic bottle racks, which were attached to a rope at intervals corresponding to the depths at which the water samples were taken. The rope was suspended from a toroid buoy and left free floating in the sea for 24 hours. A Dahn buoy with light, radio beacon and radar reflector was attached to the toroid buoy and used to locate the position of the incubation rig at various times during the day and for recovery in the early hours of the following day. Whenever possible the in-situ rigs were deployed and recovered in darkness.

One of the rigs deployed during CD114B was hit by a passing tanker, resulting in the loss of approximately 40% of the sample bottles.

Comments on Data Quality

Charles Darwin Cruise CD105 ^{14}C Data

A detailed analysis of primary production measurements made during OMEX II has indicated some anomalous data. As part of the objective was to estimate primary production from satellite remote sensing, primary production rates were compared with surface chlorophyll concentrations. It was immediately clear that the data from CD105 are different from the other measurements made by the PML group. All estimates of primary production in CD105 appear to be too high for the chlorophyll concentration present in the surface waters.

The methodology used on this cruise was the same as on cruises CD114 and Poseidon 237, except for the amount of ^{14}C apparently added to each experimental bottle. The standard procedure was to buy 1mCi ampoules of ^{14}C bicarbonate from Amersham International, which were then diluted with sterile, filtered seawater to form a working stock solution, immediately before each experimental bottle was inoculated with ^{14}C. The quantity of ^{14}C bicarbonate added was determined by adding an aliquot of the diluted ^{14}C bicarbonate to a CO_2 absorbing scintillation cocktail and counting the radioactivity in that sample. The amount of ^{14}C bicarbonate counted in this way does not usually differ in any significant way from the amount expected by the dilution of the Amersham stock. However, the measured radioactivity for CD105 was very variable and much less than expected. In some cases the ^{14}C bicarbonate measured in the CO_2 absorbing cocktail was 25% or less of the anticipated value, meaning that some bottles received as little as 2.4µCi, although the expected additions should have been 10µCi.

Since the calculation of primary production depends on the quantity of ^{14}C bicarbonate added, it is important to have an accurate measure of the ^{14}C bicarbonate added, which is why that quantity was measured directly. However, the quantity of ^{14}C bicarbonate supplied by Amersham is rigorously controlled and there has been no experience of Amersham supplying less ^{14}C bicarbonate than was indicated on the ampoule. The conclusion is that there may have been a problem with the CO_2 absorbing scintillation cocktail and that the amount of ^{14}C bicarbonate added to each bottle was underestimated. The consequences are illustrated in the Table below where the primary production rates estimated from the measured ^{14}C bicarbonate are compared with estimates based on the assumption that 10µCi ^{14}C bicarbonate were added to each sample.

It should be emphasised that there is no basis for using these alternative estimates based on the assumed ^{14}C bicarbonate addition as there are too many uncertainties in the assumption of ^{14}C stock concentrations. Nevertheless, the alternative estimates do give an indication of the minimum rate of primary production that was likely to have occurred at each station.

Station	**Measured ^{14}C addition**				**Assumed ^{14}C addition**			
Size fraction	20µm	2µm	0.2µm	TOTAL	20µm	2µm	0.2µm	TOTAL
N2000	249.51	151.13	633.25	1033.9	82.31	49.86	208.91	341.08
O140	159.7	105.64	504.68	770.02	111.26	73.6	351.62	536.5
Q2500	106.49	115.91	487.45	709.85	68.68	74.76	314.7	457.84
V2600	91.73	100.05	324.28	516.06	75.83	82.74	268.17	426.77
U200	634.25	236.03	1078.03	1948.31	316.27	117.7	537.56	971.52
T200	434.84	228.79	821.98	1485.61	171.7	90.34	324.56	586.6
R1000	477.42	262.86	992.14	1732.42	156.88	86.38	326.02	569.28
S600	311.9	198.99	783.97	1294.86	78.99	50.39	198.54	327.91
Q100	264.11	190.79	880.5	1335.4	83.62	60.4	278.76	422.78

All rates are given in units of mgC fixed m^{-2} d^{-1}.

The primary production estimates for CD105 were suspect and are likely to be too high. The alternative estimate, based on an assumed addition of ^{14}C bicarbonate, is likely to be a minimum value. The true primary production rate could lie anywhere between the 2 sets of estimates in the table.

The percentage production in each size fraction was unaffected by these problems. Comparison of the proportion of carbon fixed in each size fraction is therefore still valid.

Charles Darwin Cruise CD105B ^{15}N Data

Where the ambient nitrate and ammonium concentrations were below colorimetric autoanalysis detection (0.05µM for NO_3 and 0.1µM for NH_4) the uptake rates were supplied as a range for nitrate concentrations of between 0.01 and 0.04 µM, and ammonium concentrations between 0.05 and 0.09µM.

The data values loaded into the database in these cases are the range mid-points. The standard errors that accompany them have been set to one half of the specified range.

Charles Darwin Cruise CD114A ^{15}N Data

A small number of data were flagged as suspect either by the originator or by BODC because the screened assimilation exceeded the total assimilation.

Where the ambient nitrate concentration was below detection (0.05µM), the original data were supplied as a range for nitrate concentrations from 0.01-0.04µM. The mid-point of this range has been stored in the database and the standard deviation field has been used to store the standard error (one half of the specified range).

Where the ammonium concentration was at or below the detection limit (0.05µM), the ambient concentration has been assumed as 0.05µM. The assimilation data may therefore be an overestimate of real rate.

Charles Darwin Cruise CD114B ^{15}N Data

The ambient nitrate and ammonium concentrations were so low that stimulated uptake was the result of even the lowest tracer concentration. Consequently, the data included in the database have been corrected using Michaelis Menten kinetics assuming rate constants from Rees et al. (1999)

The urea concentrations were determined manually on frozen samples and are higher than predicted from NO_3 and NH_4 concentrations. Two intercalibration exercises have failed to clarify these data. The urea assimilation rates should therefore be treated with caution.

Dr. Lei Chou

The measurements were made on all the Belgica cruises. Water samples were taken from the CTD rosette, placed in clear plastic bottles and inoculated with approximately 20 µCi ^{32}P per 200 ml sample. The bottles were sandwiched between a series of neutral density screens to give the required light gradient and incubated for 6-12 hours in an artificial light incubator.

At the end of the incubation, the samples were filtered through GF/F filters, which were dried and subsequently counted.

Benthic Fauna Data

Introduction

The benthic fauna data are held in a series of holding tables awaiting the resources to generate the parameter codes required to integrate them into the normalised benthic data structures. The storage of the data is based on the manner in which the originators subdivided the data when supplying them to BODC.

Three sets of data were supplied, each of which is documented separately:

Benthic meiofauna data

Benthic macrofauna data

Benthic megafauna data

Benthic Meiofauna Data

Sampling Protocol

The samples were collected using one of three instruments: a multicorer, a box corer or a Craib corer fitted to the TROL lander. The box corer was a modified design (surface area 50 cm^2) fitted with a closing lid, which was capable of taking undisturbed cylindrical cores of the surface sediment. A sub-core was taken for meiofaunal analysis using a plastic tube (surface area 10 cm^2). Replicates were taken from most stations and are presented as individual profiles in the data set.

The sub-cores were sectioned into horizontal slices between 2.5mm and 50mm thick covering the top 10cm of the sediment. The slices were fixed in hot (70 °C), 4% neutral formaldehyde tap water solution.

Meiofauna organisms were extracted from the sediment by centrifugation with Ludox. Macrofauna were excluded by means of a 1mm-mesh sieve. All animals retained on a 32µm sieve were counted.

The length (excluding filiform tails, if present) and width of the slide-mounted nematodes were measured using an image analyser (Quantimet 500+) and biomass was computed using Andrassay's formula (Andrassay, 1956). A dry to wet weight ratio of 0.25 was assumed.

At BODC, the following changes were made to the data. Abundance data supplied in counts per 10 cm^2 have been converted to units per m^2 by multiplying by 100. Biomass data supplied in units of µg C/10 cm^2 have been converted to units of mg/m^2 by dividing by 10.

Benthic Macrofauna Data

Sampling Protocols

The samples were collected using a NIOZ circular box core. Two corers were used with diameters of either 30 cm or 50 cm with the smaller corer generally used at shallower stations. Some cores were sub-sampled with the remainder of the sample taken for macrofaunal analysis. The resulting variation in sample size has been taken into account with the data calculated on a per unit area basis.

The samples were sliced into layers between 1 and 5 cm thick and sieved through a 0.5 mm mesh. Specimens were preserved in 4% buffered formaldehyde, stained with Rose Bengal and sorted under a 10x stereo microscope.

Biomass was estimated as wet weight per major taxon after drying the animals for a few seconds on absorbent paper. Weighing was done to an accuracy of 0.1 mg. Due to their small size, no attempt was made to puncture the shells of bivalves to drain them of water.

Data Presented

Total macrofauna abundance profiles.

Whole-core macrofauna abundance and wet weight biomass at the group level with Echinodermata, Arthropoda and Mollusca subdivided into lower level taxa.

Benthic Megafauna Data

Sampling Protocol

An Agassiz trawl was used with an opening 1 m high and 3.5 m wide. The aperture is fitted with a mechanical trap door to prevent organisms being caught during lowering and hauling. The stretched mesh width of the net used was 1 cm. The trawl was kept on the sea floor by a 750kg weight attached to the cable 500 m ahead of the trawl. The fishing distance was estimated using a 1m-diameter odometer wheel, which was checked by a video camera fitted to the trawl with a real time counter and logged cable tension data.

The catch was sieved on board with a mesh size of 5mm. Most organisms were preserved in formalin except for selected species that were dissected immediately. Parts of the body wall and the gut contents of these were frozen in liquid nitrogen and stored at -80 °C.

The taxonomy of the trawl samples was studied in the laboratory and the principal taxa were counted. All specimens were wet weighed. Carbon weights were calculated using the deep sea animal conversion factors given in Rowe (1983).

Data Presented

The following are included in the data set.

Total abundance.
Total biomass (wet weight)
Abundance of the principal taxa.
Biomass of the principal taxa (wet weight)
Population by feeding guild (abundance and wet weight biomass)
Total principal taxa biomass (carbon).

Continuous Plankton Recorder

Sampling Protocol

The Continuous Plankton Recorder (CPR) has been deployed continuously on ships of opportunity since the early 1960s. The instrument is towed at a depth of approximately 10 m and water is continuously filtered through gauze that is wound through the instrument onto a spool in a tank of preservative.

Back at the Sir Alister Hardy Foundation for Ocean Science, the gauze was cut into sections such that each sample represented approximately 10 nautical miles of track. The samples were analysed for phytoplankton and zooplankton abundance, to species where possible, or higher taxonomic groups. Chlorophyll concentration was estimated by visual assessment of the colour of the gauze.

The estimated abundance presented in the data is the 'accepted value' for the CPR quantification class divided by the fraction of the sample counted. For phytoplankton, the quantification class definitions are as follows:

Accepted value	Class Limits
0	Presence
1.5	1-2
3.5	3-4
6.5	6-7
9.5	9-10
13	12-14
17	16-18
22.5	21-24
30	28-32
42	38-46
75	60-90

For zooplankton, the quantification class definitions are:

Accepted value	**Class Limits**
0	Presence
1	1-1
2	2-2
3	3-3
6	4-11
17	12-25
35	26-50
75	51-125
160	126-250
310	251-500
640	501-1000
1300	1001-2000
2690	2001-4000

Further details of CPR operations may be found in Colebrook (1960) and Glover (1967).

Data were supplied from routes crossing the shelf break in the vicinity of the Goban Spur from 1964 to 1995.

Menten-Michaelis Phosphate Uptake Kinetics

Method

Water samples were collected in 10-litre Niskin bottles mounted on a CTD rosette. Up to 10 clear plastic bottles were filled and inoculated with approximately 20 Ci of ^{32}P. Varying amounts of unlabelled PO_4 were quantitatively added to the bottles, providing a range of phosphate concentrations from 0.01 to 1 μM.

The samples were incubated at surface seawater temperature at a fixed illumination level of 188 $\mu E/m^2/s$ for 4-6 hours. After incubation, the samples were filtered through GF/F filters for total uptake or a 2-micron/0.2-micron pore-filter cascade for size-fractionated uptake. The filters were dried and subsequently counted.

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